North Atlantic and Global HYCOM Evaluation

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Motivation: Improved Model Component in 1/12° Global-HYCOM Nowcast/Forecast System
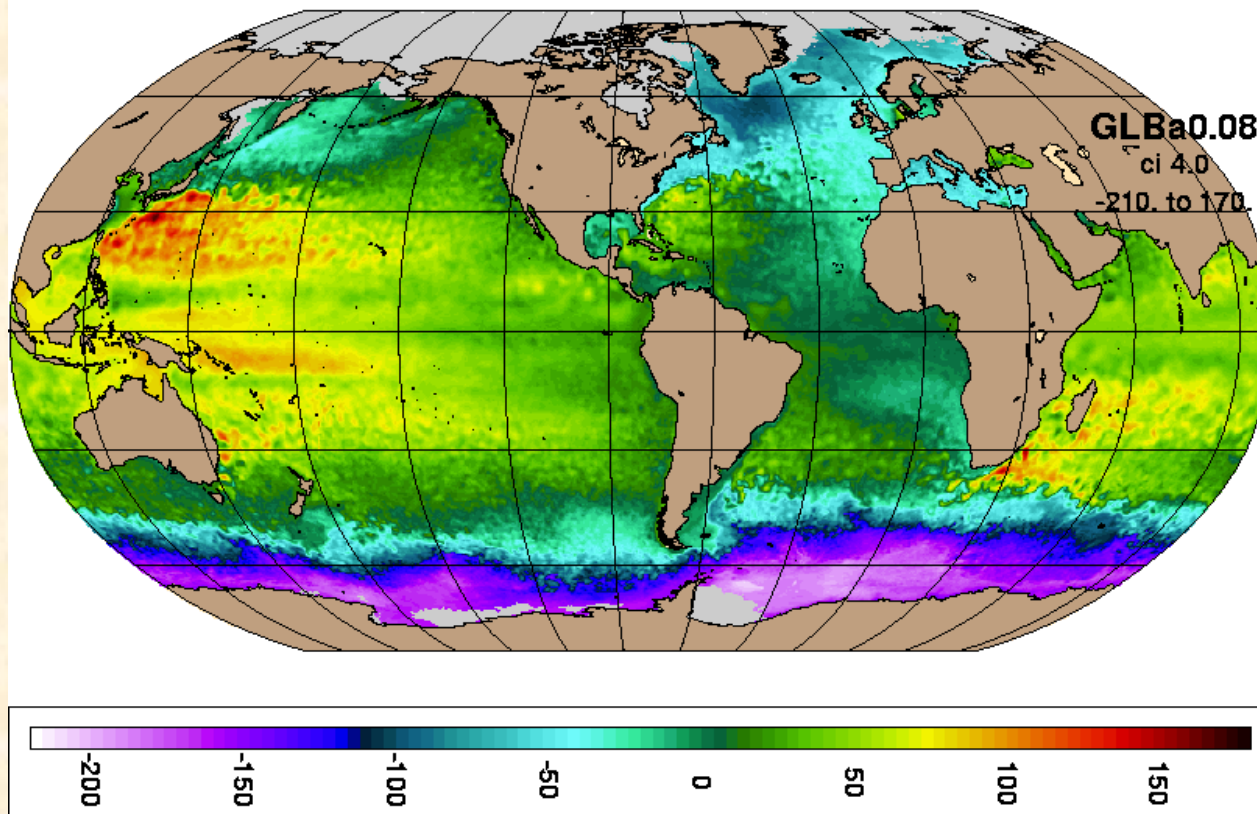
Present Data-assimilative Run

Model Developments Impacting Simulation of The Gulf Stream System (GSS)

Boundary relaxation time scale
>Impact on MOC amplitude – Key component of GSS

Advection scheme (MPDATA vs FCT2)
>Impact on subpolar gyre mixed layer depth – affects MOC amplitude
>Impact on MOC amplitude – Key component of GSS

Bottom topography (sills)
>Impact on flow pathways – Critical for both thermohaline- and
>>Wind-driven components of GSS

Turbulent mixing scheme
>Impact on diffusion which in turn impacts the structure within the GSS

Diffusion parameterization
>Impact on strength, pathway, and energy levels of GSS

Wind Forcing
>Impact on strength, pathway, and energy levels of GSS

Atlantic/Global HYCOM Experiments Used in Analysis

Experiment	Smag. Diffusion	A	Biharmonic Dissipation	Mixed Layer	Wind Forcing	Model Years
ATLd0.08-11.4	0.1	53 @ 38N	.01	KPP	ERA15	10-11
ATLd0.08-11.8	.05	20	.01	KPP	ERA15	09-10
ATLd0.08-12.0	.05	25	.01	KPP	ERA15	11-13
ATLd0.08-12.1	.1	30	.01	KPP	ERA15	12-13/12-15
ATLd0.08-12.2	.05	30	.01	KPP	ERA15	11-13
ATLd0.08-12.3	.1	30	.01	KPP	1.2 x ERA15	11-13
ATLd0.08-12.4	.1	30	.01	GISS	ERA15	12-13
ATLg0.04-01.2	.05	15	.01	KPP	ERA15	11-12
GLBa0.08-05.2	.1	30	.01	GISS	ERA15	8-9
GLBa0.08-05.6	.05	20	.02	GISS	ERA15	9-10/9-12
GLBa0.08-07.1	.05	20	.02	GISS	QuikSCAT scaled ERA40	4

# Simulated vs. Observed Surface EKE

GLB a0.08 - 5.6, years 9-10
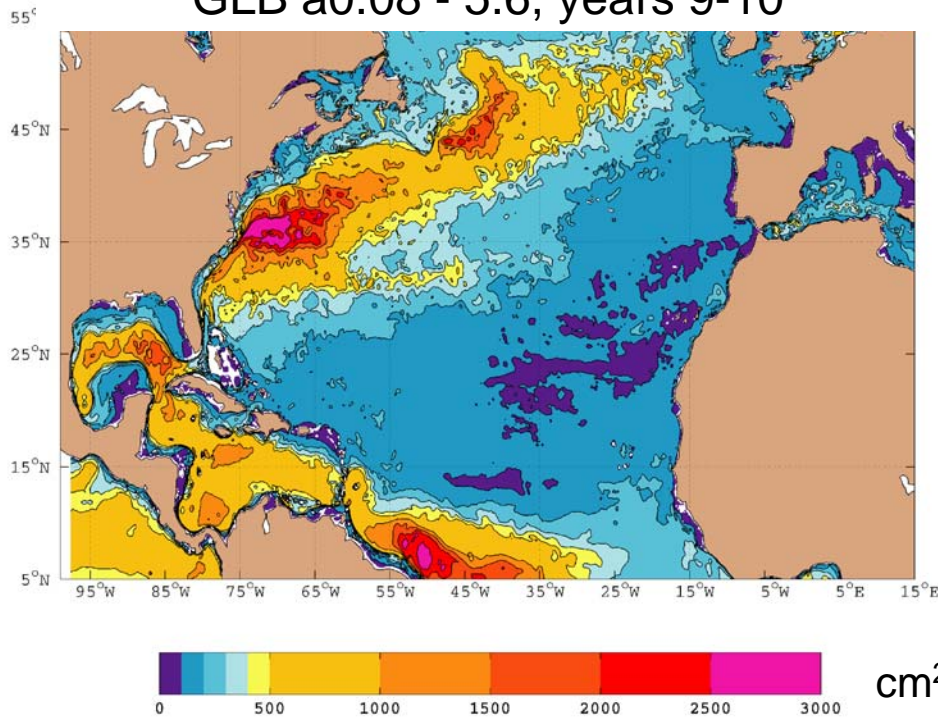
Fratantoni (JGR – 2001)

cm²/sec²
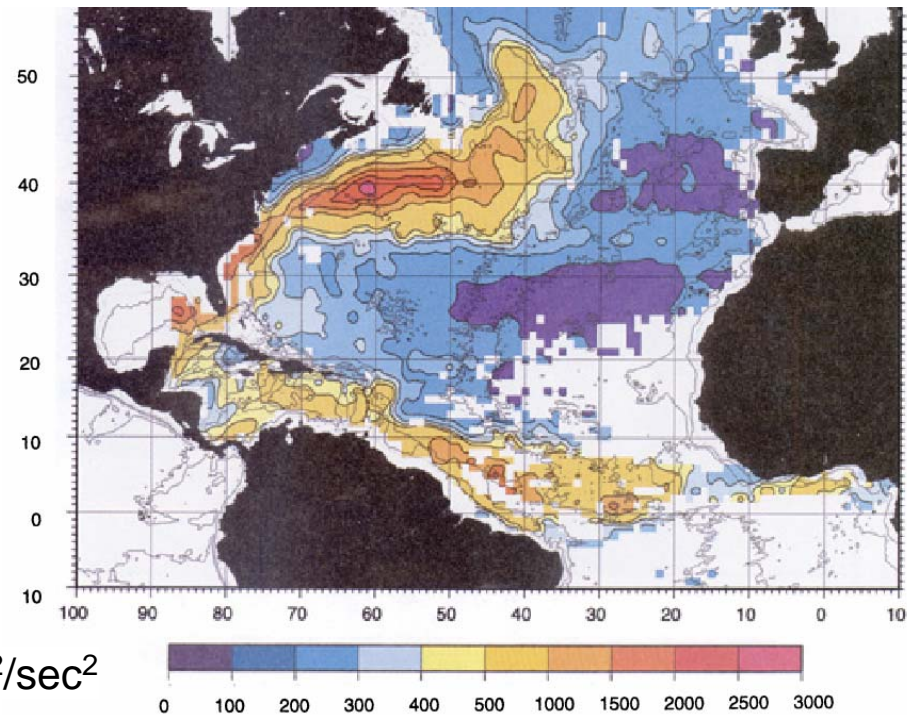
- High EKE in the Gulf Stream doesn't extend far enough to the east
- EKE in North Atlantic Current and its extension is too high

Locations of Simulated EKE Profiles vs. Observations Comparisons in the Gulf Stream System

sea surf. height   year   3.11 (Feb 10) [07.1H]

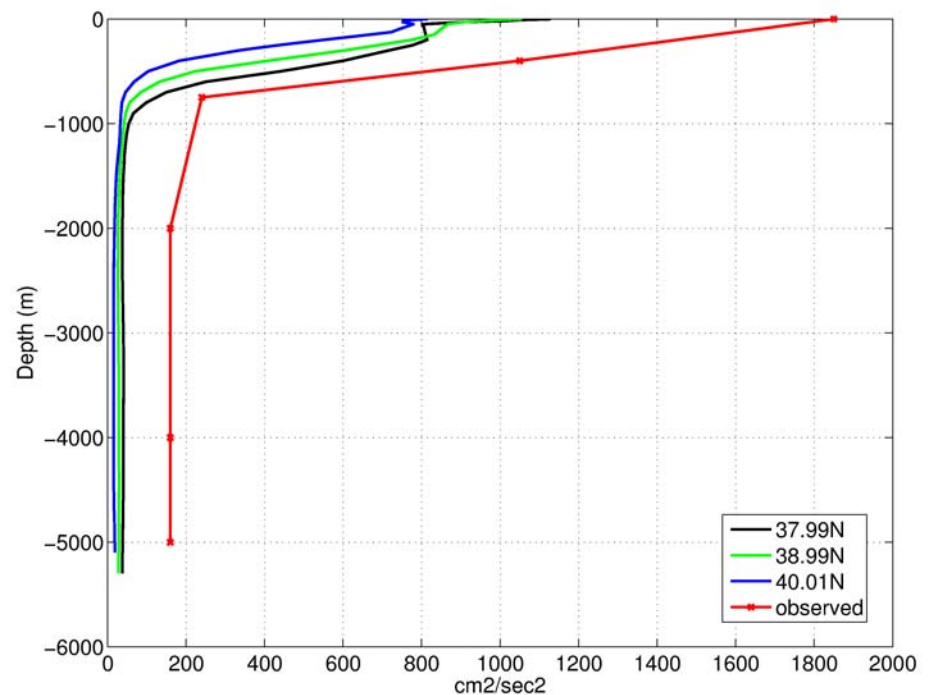Gulf Stream @ 68W   Gulf Stream Extension (GSE) Region
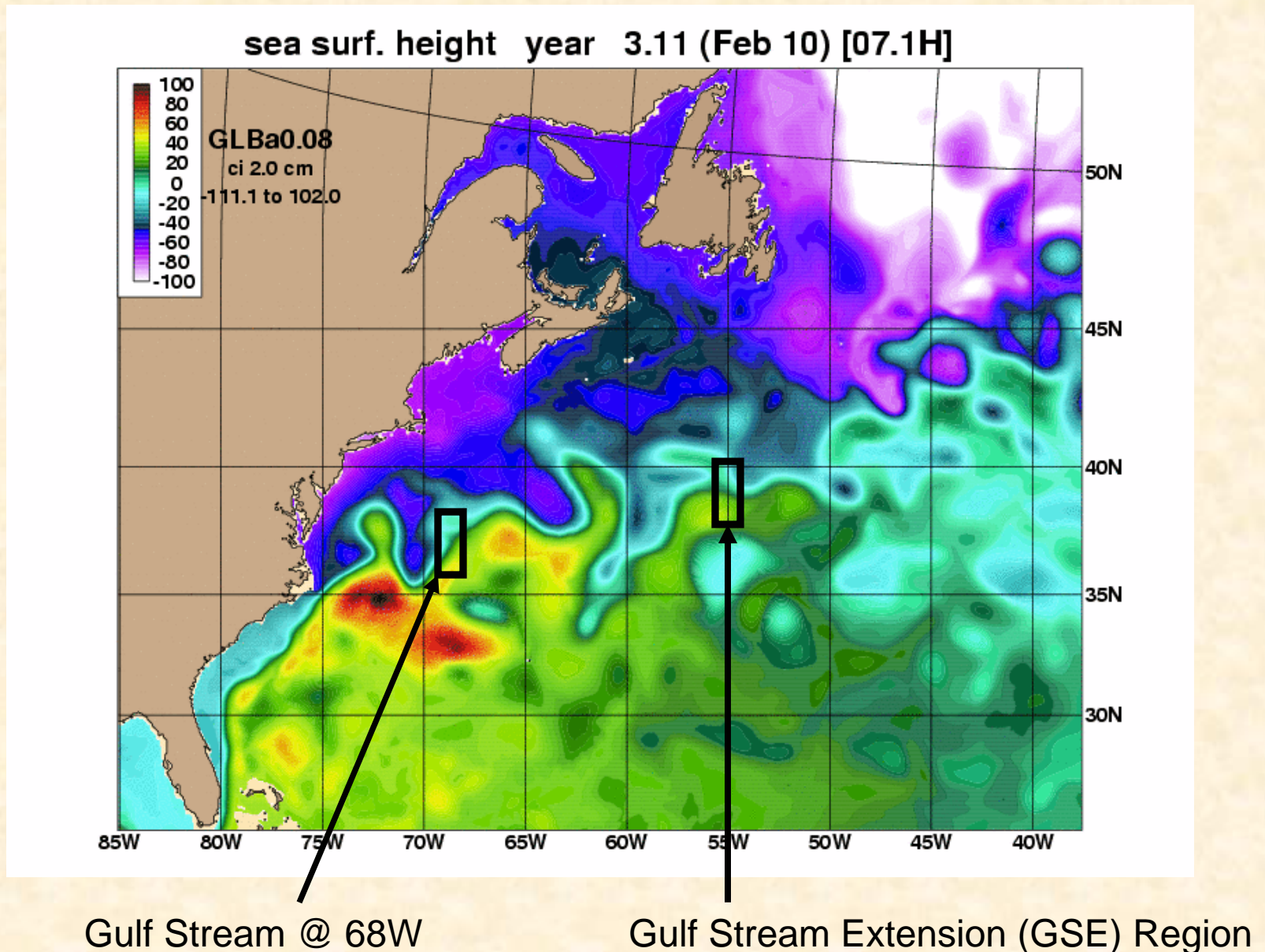
Simulated EKE Profiles vs. Observations @ 55W – Gulf Stream Extension (GSE)

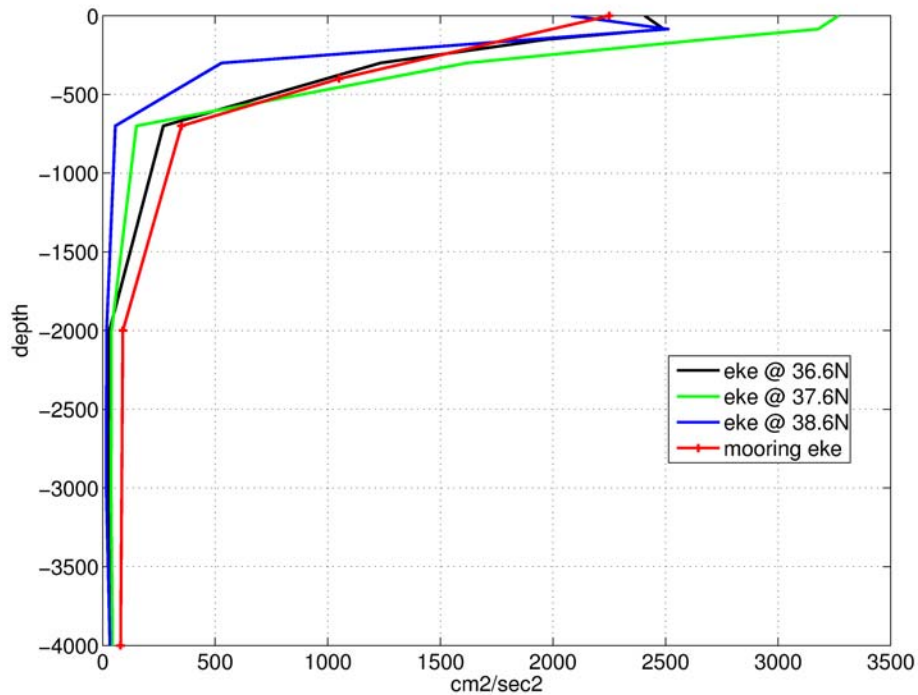ATL d0.08 – 12.1, years 12-15
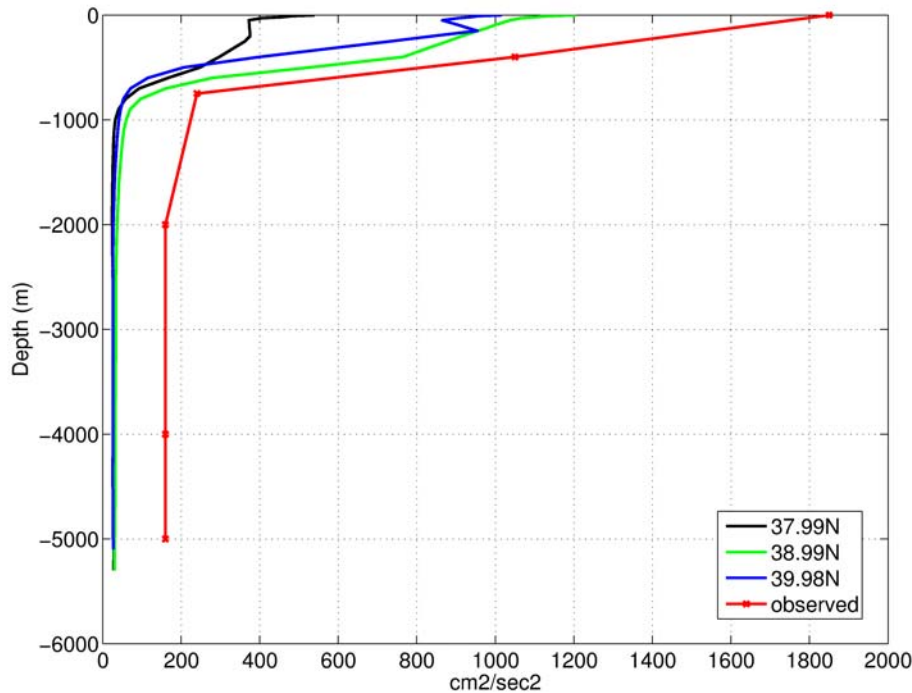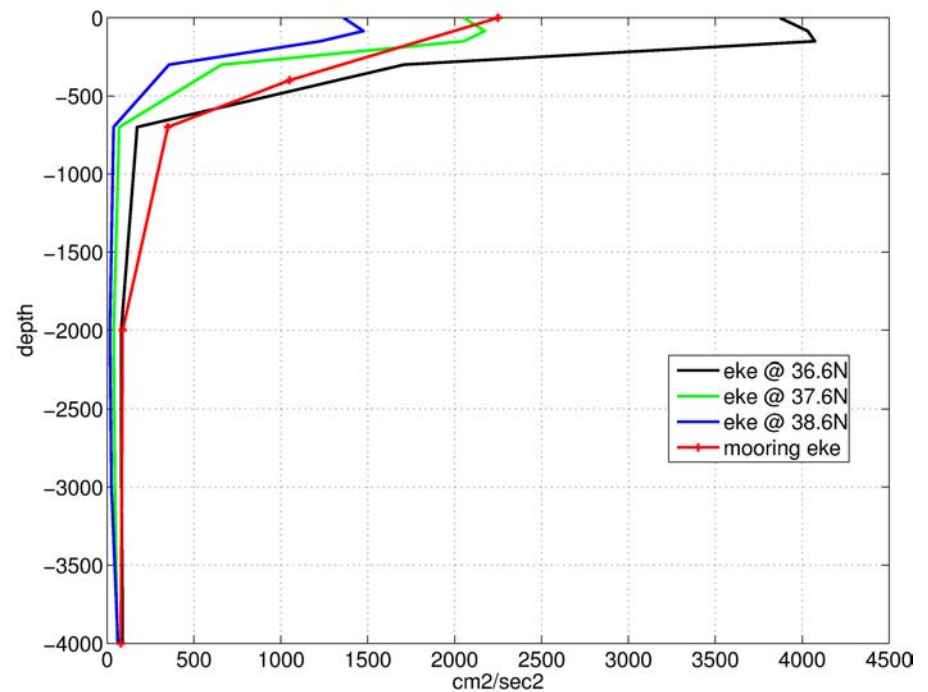
ATL g0.04 – 01.2, years 11-12

- Modeled EKE is too low in comparison to observations, especially deep
- Doubling the resolution didn't have much effect on upper or deep/abyssal EKE

Simulated EKE Profiles vs. Observations – Gulf Stream @ 68W
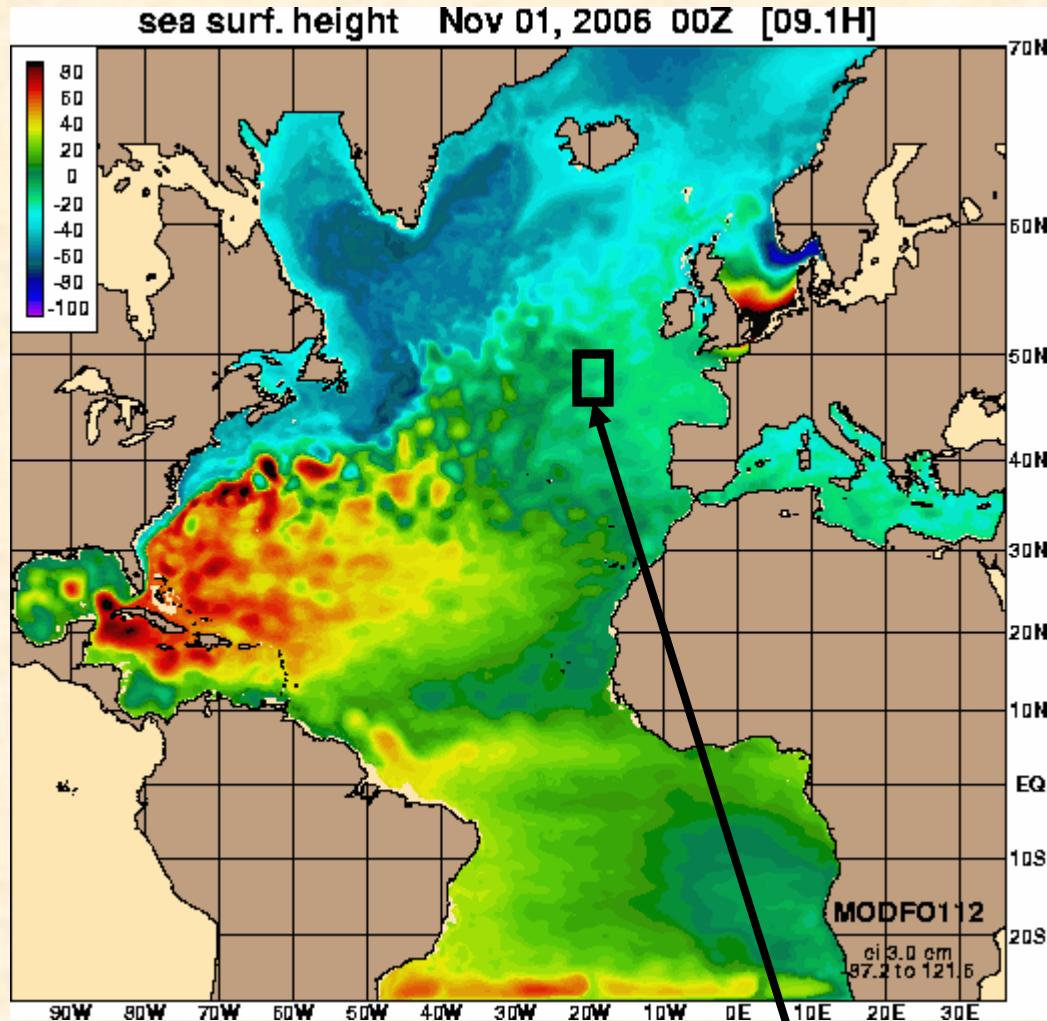

ATL d0.08 – 11.4, years 9-10

ATL g0.04 – 01.2, years 11-12

Varying degrees of agreement with observations, depending on simulation

Locations of Simulated EKE Profiles vs. Observations Comparisons in the North Atlantic Current Region

North Atlantic Current Extension (NACE)

Simulated EKE Profile vs. Observations – NAC Extension

GLBa0.08 – 05.2, years 8-9

Legend:
- eke @ 20W 47.5N
- eke @ 20W 48N
- eke @ 20W 48.5N
- observed
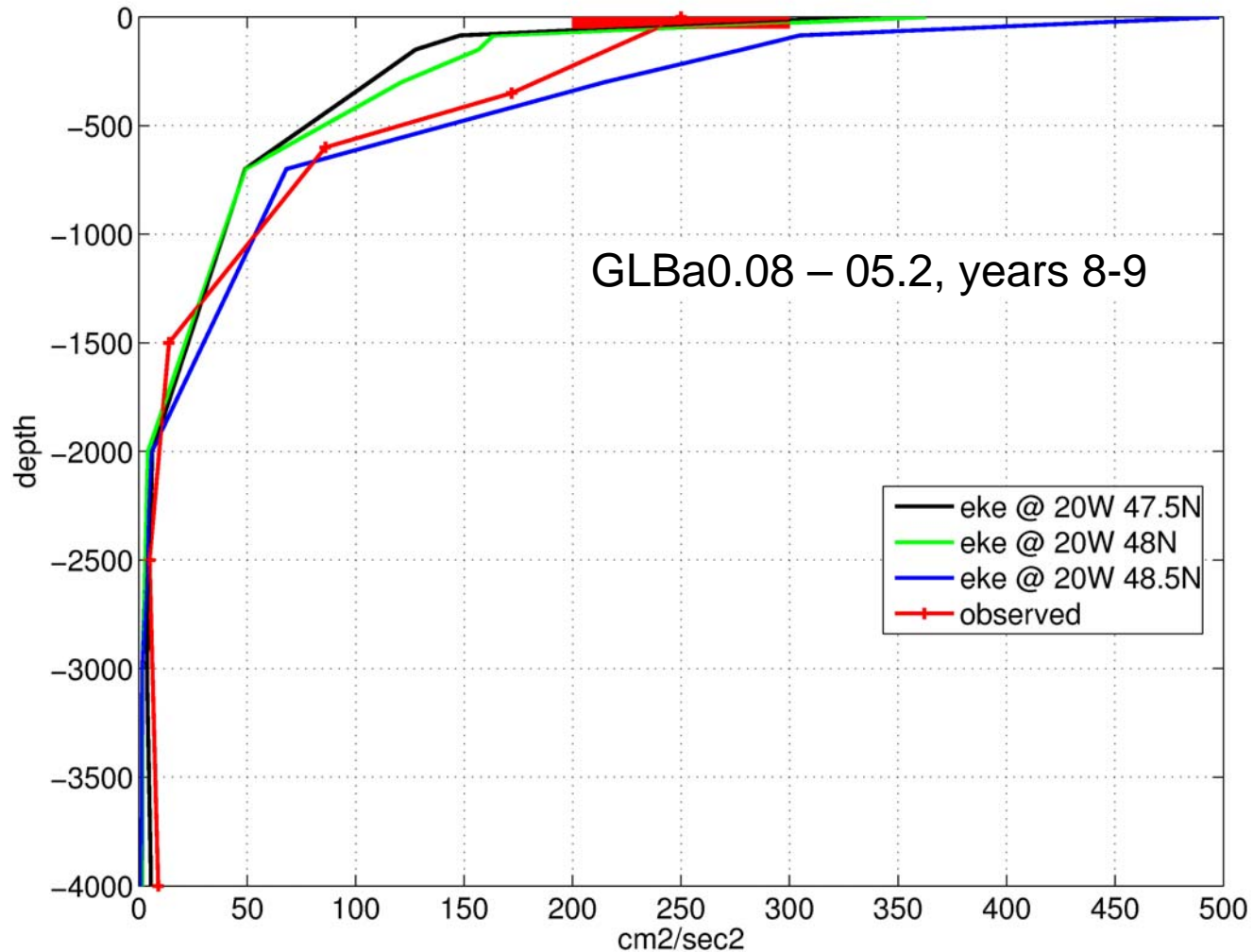
Generally good agreement below 350m depth
Divergence near surface

Improving the Wind Forcing

Global HYCOM experiment (in progress on Cray XT3 @ ERDC MSRC) forced by ERA40 winds corrected using QuikSCAT wind speed globally (ERA-40 winds are generally too weak) is expected to improve results in the Gulf Stream system

Section	Obs. In Sv	GLBa0.08 – 05.2	Linear ERA15	Linear ERA40	Linear-C ERA40
Florida Current + Abaco	37	32.0	34.2	34.4	37.5

- ERA = ECMWF reanalysis • HYCOM was forced by ERA15
- Linear = linear NLOM solution based on Sverdrup (1947) interior flow with Munk (1950) western boundary currents, and islands added
- Allows efficient comparison and evaluation of ocean currents forced by different wind products, 26 different wind sets tested so far.
- Linear-C is ERA40 with annual mean winds corrected by a QuikScat climatology
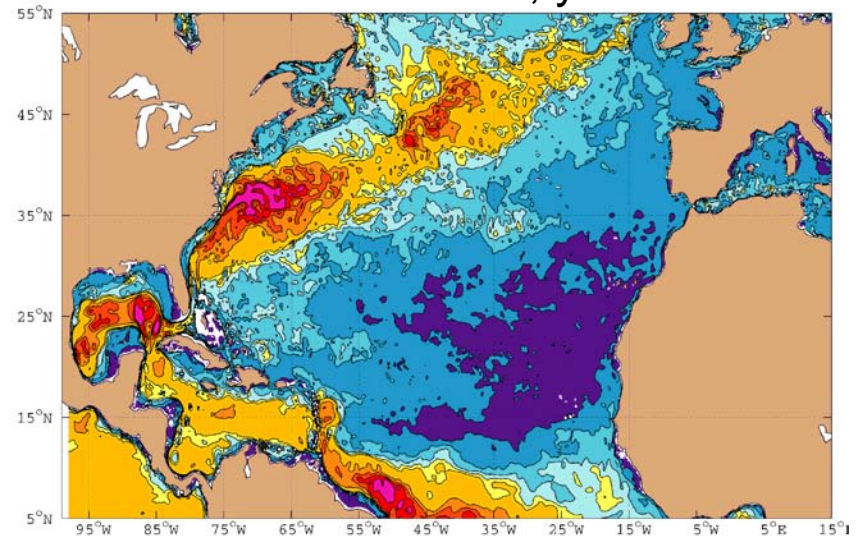
Simulated Surface EKEs

GLB a0.08 - 5.6, years 9-10   GLB a0.08 – 7.1, year 4
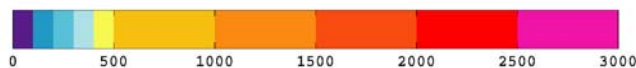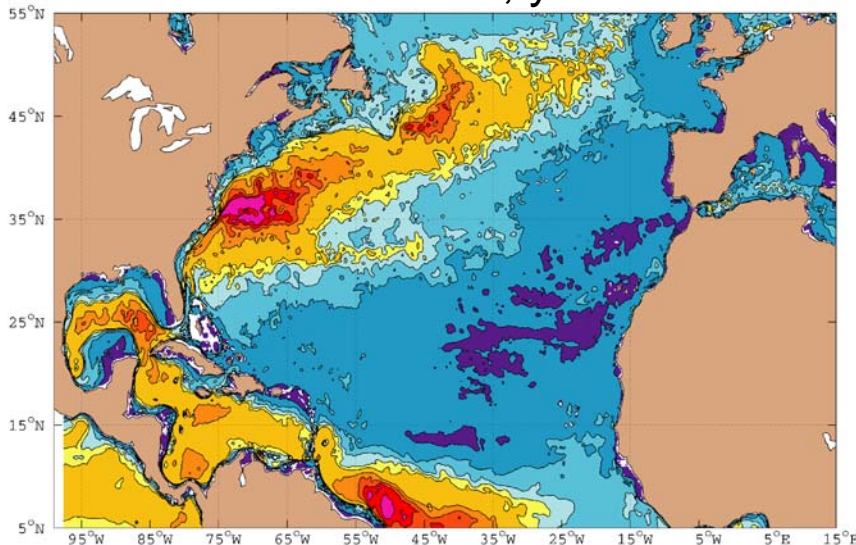
cm^2/sec^2

Too early to see improvement (statistics are from second completed year using QuikSCAT scaled ERA-40 winds), stay tuned ...

Future Work

More diverse intercomparisons in the Atlantic and
expanding into other basins

         - We've already done some intercomparisons
         in the Kuroshio and Agulhas